CLAIMS

1. An implantable pump (1) for pumping hydraulic fluid to or from a hydraulically operable surgical implant (14;19) inside a human's or an animal's body, the pump comprising a wall (2) forming a chamber (3) for the hydraulic fluid, the wall including a first wall portion (4) and a second wall portion (5), which is displaceable relative to the first wall portion to change the volume of the chamber (3) to pump the hydraulic fluid between the chamber and the surgical implant, **characterized** in that the second wall portion includes a displaceable membrane (5) that is penetrable by an injection needle (17) to add hydraulic fluid to or withdraw hydraulic fluid from the chamber (3), and that the membrane is self-sealing to seal the hole which is formed in the membrane by the penetrating injection needle.

2. An implantable pump according to claim 1, wherein the membrane (5) is manually displaceable.

3. An implantable pump according to claim 1 or 2, wherein the membrane (5) is displaceable relative to the first wall portion (4) between a first position (Fig. 2), in which the chamber (3) has a first volume, and a second position (Fig. 3), in which the chamber has a second volume smaller than the first volume.

4. An implantable pump according to claim 3, wherein the membrane (5) is flexible and takes the shape of a semi-sphere, when it is in the first position.

5. An implantable pump according to claim 4, further comprising a locking device (13) adapted to releasably lock the membrane (5) in the second position.

6. An implantable pump according to claim 5, wherein the locking device (13) is adapted to lock the membrane (5) in the second position, when the membrane is manually pushed from the first position to the second position.

7. An implantable pump according to claim 6, wherein the locking device (13) is adapted to release the membrane (5) from the second position upon pushing the membrane, and the membrane is adapted to resume its semi-spherical shape in the first position, when it is released from the second position.

8. An implantable pump according to any one of claims 4-7, wherein the chamber (3) is substantially emptied, when the membrane (5) is in the second position.

9. An implantable pump according to any one of claims 1-8, wherein the membrane (5) includes a first layer (6) and a second layer (7) attached to each other, the first layer (6) having better strength properties than the second layer and the second layer (7) having better sealing properties than the first layer.

10. An implantable pump according to claim 9, wherein the first layer (6) is harder than the second layer (7).

11. An implantable pump according to claim 10, wherein the second layer (7) is situated between the first layer (6) and the chamber (3).

12. An implantable pump according to claim 11, wherein the membrane (5) comprises a third layer (8) harder than the

second layer (7), the third layer being situated between the second layer (7) and the chamber (3).

13. An implantable pump according to any one of claims 9-12, wherein the second layer (7) is made of silicone having a hardness of less than 20 Shore.

14. Use of an implantable pump according to any one of the preceding claims for pumping hydraulic liquid to and from hydraulic implants designed for treating reflux disease, urine incontinence, impotence, anal incontinence or obesity.

15. An apparatus for treating a disease, comprising a hydraulically operable surgical implant, and an implantable pump (1) for pumping hydraulic fluid to or from the surgical implant (14;19), the pump including a wall (2) forming a chamber (3) for the hydraulic fluid, the wall including a first wall portion (4) and a second wall portion (5), which is displaceable relative to the first wall portion to change the volume of the chamber (3) to pump the hydraulic fluid between the chamber and the surgical implant, **characterized** in that the second wall portion includes a displaceable membrane (5) that is penetrable by an injection needle (17) to add hydraulic fluid to or withdraw hydraulic fluid from the chamber (3) of the pump (1).

16. An apparatus according to claim 15, wherein the surgical implant comprises a hydraulic constriction device (14;19) for constricting a passageway of an organ of a human or an animal.

17. An apparatus according to claim 16, wherein the constriction device (14) comprises an inflatable cavity (16), which is in fluid communication with the chamber (3) of the

pump (1), and the cavity is adapted to constrict the passageway when it is inflated and to release the passageway when it is deflated.

18. An apparatus according to claim 16, wherein the constriction device (19) comprises a relatively small first inflatable cavity (20), which is in fluid communication with the chamber (3) of the pump (1), and a relatively large second cavity (21), which is displaceable by the first cavity, and the first cavity is adapted to displace the second cavity to constrict the passageway when the first cavity is inflated and to displace the second cavity to release the passageway when the first cavity is deflated.

19. An apparatus according to claim 18, wherein the second cavity (21) is inflatable by fluid, and further comprising an injection port (23), which is in fluid communication with the second cavity, whereby the volume of the second cavity can be calibrated by adding fluid to or withdrawing fluid from the injection port.

20. An apparatus according to any one of claims 15-19, wherein the membrane (5) is manually displaceable.

21. An apparatus according to any one of claims 15-20, wherein the membrane (5) is displaceable relative to the first wall portion (4) between a first position (Fig. 2), in which the chamber (3) has a first volume, and a second position (Fig. 3), in which the chamber has a second volume smaller than the first volume.

22. An apparatus according to claim 21, wherein the membrane (5) is elastic and takes the shape of a semi-sphere, when it is in the first position.

23. An apparatus according to claim 22, further comprising a locking device (13) adapted to releasably lock the membrane (5) in the second position.

24. An apparatus according to claim 23, wherein the locking device (13) is adapted to lock the membrane (5) in the second position, when the membrane is manually pushed from the first position to the second position.

25. An apparatus according to claim 24, wherein the locking device (13) is adapted to release the membrane (5) from the second position upon pushing the membrane, whereby the membrane resumes its semi-spherical shape in the first position.

26. An apparatus according to any one of claims 15-25, wherein the chamber (3) is substantially emptied, when the membrane (5) is in the second position.

27. An apparatus according to any one of claims 15-26, wherein the membrane (5) includes a first layer (6) and a second layer (7) attached to each other, the first layer (6) having better strength properties than the second layer and the second layer (7) having better sealing properties than the first layer.

28. An apparatus according to claim 27, wherein the first layer (6) is harder than the second layer (7).

29. An apparatus according to claim 28, wherein the second layer (7) is situated between the first layer (6) and the chamber (3).

30. An apparatus according to claim 29, wherein the membrane (5) comprises a third layer (8) harder than the second layer (7), the third layer being situated between the second layer (7) and the chamber (3).

31. An apparatus according to any one of claims 27-30, wherein the second layer (7) is made of silicone having a hardness of less than 20 Shore.

32. A method of operating a hydraulically operable surgical implant (14;19) implanted in a human or an animal, the method comprising:

subcutaneously implanting in the human or animal a pump (1) having an injection membrane (5), which is displaceable to change the volume of a hydraulic fluid chamber (3) in the pump;

hydraulically connecting the hydraulic fluid chamber via a conduit (15) to the hydraulically operable surgical implant to form a closed hydraulic fluid distribution system including the fluid chamber, conduit and surgical implant;

calibrating the amount of hydraulic fluid in the fluid distribution system by penetrating the patient's skin (9) and the membrane of the implanted pump with an injection needle (17) and adding hydraulic fluid to or withdrawing hydraulic fluid from the fluid chamber; and

from time to time, operating the surgical implant by displacing the injection membrane of the subcutaneously implanted pump, so that hydraulic fluid is distributed between the fluid chamber of the pump and the surgical implant.

33. A method according to claim 32, wherein the surgical implant is operated by manually or magnetically displacing the injection membrane.

34. A method according to claim 32, wherein the surgical implant is operated by displacing the injection membrane with the aid of a motor.

35. An implantable pump according to claim 1, 3-13, wherein the membrane (5) is magnetically displaceable.

36. An apparatus according to any one of claims 15-19, 21-31, wherein the membrane (5) is magnetically displaceable.

37. An apparatus according to claim 15, wherein the surgical implant and pump are connected to form an operable pump assembly.

38. An apparatus according to claim 37, further comprising an implantable operation device adapted to operate the pump assembly.

39. An apparatus according to claim 38, further comprising an implantable motor for driving the operation device.

40. An apparatus according to claim 39, wherein the motor is designed to be powered by wireless energy emitted outside the patient's body.

41. An apparatus according to claim 37 further comprising an energy transmission device for wireless transmission of energy from outside the patient's body to inside the patient's body for use in connection with the operation of the pump assembly.

42. An apparatus according to claim 41, wherein the energy transmission device transmits energy of a first form and the pump assembly is operable in response to energy of a second form, and further comprising an energy transforming device implantable in the patient for transforming the energy of the first form wirelessly transmitted by the energy transmission device into the energy of the second form.

43. An apparatus according to claim 42, wherein the energy of the second form is different than the energy of the first form.

44. An apparatus according to claim 42, wherein the energy transforming device comprises at least one element having a positive region and a negative region, the element is capable of creating an energy field between the positive and negative regions when exposed to the energy of the first form transmitted by the energy transmission device, and the energy field produces the energy of the second form.

45. An apparatus according to claim 44, wherein the element comprises an electrical junction element, and the electrical junction element is capable of inducing an electric field between the positive and negative regions when exposed to the energy of the first form transmitted by the energy transmission device, whereby the energy of the second form comprises electric energy.

46. An apparatus according to claim 42, wherein the energy transforming device is adapted to transform the energy of the first form directly or indirectly into the energy of the second form.

47. An apparatus according to claim 46, further comprising an implantable motor for operating the pump assembly, wherein the motor is powered by the energy of the second form.

48. An apparatus according to claim 47, wherein the pump assembly is operable to perform a reversible function and the motor is capable of reversing the function.

49. An apparatus according to claim 47, further comprising a control device adapted to shift polarity of the energy of the second form to reverse the motor.

50. An apparatus according to claim 47, wherein the energy transforming device is adapted to directly power the motor by the transformed energy, as the energy of the second form is being transformed from the energy of the first form.

51. An apparatus according to claim 46, wherein the wireless energy of the first form comprises sound waves and the energy of the second form comprises electric energy.

52. An apparatus according to claim 42, further comprising an energy storage device implantable in the patient for storing the energy of the second form and for supplying energy in connection with the operation of the pump assembly.

53. An apparatus according to claim 52, wherein the energy storage device comprises an accumulator.

54. An apparatus according to claim 53, wherein the accumulator comprises at least one capacitor or at least one

rechargeable battery, or a combination of at least one capacitor and at least one rechargeable battery.

55. An apparatus according to claim 42, further comprising a source of energy implantable in the patient for supplying energy for the operation of the pump assembly, and a switch operable by the energy of the second form supplied by the energy transforming device to switch from an off mode, in which the source of energy is not in use, to an on mode, in which the source of energy supplies energy for the operation of the pump assembly.

56. An apparatus according to claim 42, further comprising an implantable stabiliser for stabilising the energy of the second form.

57. An apparatus according to claim 56, wherein the energy of the second form comprises electric current and the stabiliser comprises at least one capacitor.

58. An apparatus according to claim 41, further comprising implantable electrical components including at least one voltage level guard.

59. An apparatus according to claim 41, wherein the energy transmission device is adapted to transmit wireless energy for direct use in connection with the operation of the pump assembly, as the wireless energy is being transmitted.

60. An apparatus according to claim 41, wherein the energy transmission device is adapted to transmit wireless energy in the form of a magnetic field or electromagnetic waves for direct power of the pump assembly.

61. An apparatus according to claim 42, wherein the energy transforming device directly operates the pump assembly with the energy of the second form in a non-magnetic, non-thermal or non-mechanical manner.

62. An apparatus according to claim 42, wherein the energy transforming device comprises at least one semiconductor type of component.

63. An apparatus according to claim 62, wherein the semiconductor component comprises at least one element having a positive region and a negative region, the element is capable of creating an energy field between the positive and negative regions when exposed to the energy of the first form transmitted by the energy transmission device, and the energy field produces the energy of the second form.

64. An apparatus according to claim 37, wherein the pump assembly is operable to perform a reversible function.

65. An apparatus according to claim 64, further comprising a reversing device implantable in the patient for reversing the function performed by the pump assembly.

66. An apparatus according to claim 65, wherein the control device controls the reversing device to reverse the function performed by the pump assembly.

67. An apparatus according to claim 65, wherein the reversing device comprises hydraulic means including a for shifting the flow direction of a liquid flow in the hydraulic means.

68. An apparatus according to claim 65, wherein the reversing device comprises a mechanical reversing device.

69. An apparatus according to claim 65, wherein the reversing device comprises a switch.

70. An apparatus according to claim 41, wherein the energy transmission device transmits energy by at least one wireless signal.

71. An apparatus according to claim 70, wherein the signal comprises a wave signal.

72. An apparatus according to claim 71, wherein the wave signal comprises an electromagnetic wave signal including one of an infrared light signal, a visible light signal, an ultra violet light signal, a laser signal, a micro wave signal, a radio wave signal, an x-ray radiation signal, and a gamma radiation signal.

73. An apparatus according to claim 71, wherein the wave signal comprises a sound or ultrasound wave signal.

74. An apparatus according to claim 70, wherein the signal comprises a digital or analog signal, or a combination of a digital and analog signal.

75. An apparatus according to claim 42, wherein the energy of the first form transmitted by the energy transmission device comprises an electric, an electromagnetic or a magnetic field, or a combination thereof.

76. An apparatus according to claim 75, wherein the electric, electromagnetic or magnetic field, or the

combination thereof is transmitted in pulses or digital pulses, or a combination of pulses and digital pulses by the energy transmission device.

77. An apparatus according to claim 42, wherein the energy transforming device transforms the energy of the first form into a direct current or pulsating direct current, or a combination of a direct current and pulsating direct current.

78. An apparatus according to claim 42, wherein the energy transforming device transforms the energy of the first form into an alternating current or a combination of a direct and alternating current.

79. An apparatus according to claim 42, wherein one of the energy of the first form and the energy of the second form comprises magnetic energy, kinetic energy, sound energy, chemical energy, radiant energy, electromagnetic energy, photo energy, nuclear energy or thermal energy.

80. An apparatus according to claim 42, wherein one of the energy of the first form and the energy of the second form is non-magnetic, non-kinetic, non-chemical, non-sonic, non-nuclear or non-thermal.

81. An apparatus according to claim 42, wherein the energy transmission device functions different from the energy transforming device.

82. An apparatus according to claim 42, wherein the energy transmission device functions similar to the energy transforming device.

83. An apparatus according to claim 42, wherein the energy transforming device is designed to be implanted subcutaneously or in the abdomen, thorax or cephalic region of the patient.

84. An apparatus according to claim 42, wherein the energy transforming device is designed to be implanted in an orifice of the patient's body and under the mucosa or intraluminar outside the mucosa of the orifice.

85. An apparatus according to claim 15, further comprising at least one sensor adapted to be implanted in the patient.

86. An apparatus according to claim 85, wherein the sensor is adapted to sense at least one physical parameter of the patient.

87. An apparatus according to claim 85, wherein the sensor is adapted to sense at least one functional parameter of a medical implant.

88. An apparatus according to claim 85, further comprising a control device for controlling the surgical implant and pump in response to signals from the sensor.

89. An apparatus according to claim 88, wherein the control device comprises an implantable internal control unit that directly controls the surgical implant and pump in response to signals from the sensor.

90. An apparatus according to claim 88, wherein the control device comprises an external control unit outside the

patient's body for controlling the surgical implant and pump in response to signals from the sensor.

91. An apparatus according to claim 37, further comprising a control device for controlling the pump assembly.

92. An apparatus according to claim 91, wherein the control device comprises a remote control for controlling the pump assembly from outside the patient's body.

93. An apparatus according to claim 92, wherein the remote control comprises a wireless remote control.

94. An apparatus according to claim 93, wherein the wireless remote control is adapted to transmit at least one wireless control signal for controlling the pump assembly.

95. An apparatus according to claim 95, wherein the control signal comprises a frequency, amplitude or frequency or amplitude modulated signal.

96. An apparatus according to claim 94, wherein the control signal comprises an analog or a digital signal, or a combination of an analog and digital signal.

97. An apparatus according to claim 91, wherein the control device comprises a microprocessor.

98. An apparatus according to claim 93, wherein the wireless remote control comprises at least one external signal transmitter or transceiver and at least one internal signal receiver or transceiver implantable in the patient.

99. An apparatus according to claim 94, wherein the remote control transmits a carrier signal for carrying the control signal.

100. An apparatus according to claim 99, wherein the carrier signal comprises digital, analog or a combination of digital and analog signals.

101. An apparatus according to claim 100, wherein the signals comprise wave signals.

102. An apparatus according to claim 94, wherein the control signal comprises a wave signal comprising one of a sound wave signal, an ultrasound wave signal, an electromagnetic wave signal, an infrared light signal, a visible light signal, an ultra violet light signal, a laser light signal, a micro wave signal, a radio wave signal, an x-ray radiation signal and a gamma radiation signal.

103. An apparatus according to claim 94, wherein the control signal comprises an electric or magnetic field, or a combined electric and magnetic field.

104. An apparatus according to claim 96, wherein the remote control transmits an electromagnetic carrier wave signal for carrying the digital or analog control signal.

105. An apparatus according to claim 37, further comprising an external data communicator and an implantable internal data communicator communicating with the external data communicator, wherein the internal communicator feeds data related to the pump assembly back to the external data communicator or the external data communicator feeds data to the internal data communicator.

106. A pump according to claim 1, further comprising an operation device adapted to operate the membrane.

107. A pump according to claim 106, further comprising a motor for driving the operation device.

108. A pump according to claim 107, wherein the pump is adapted for implantation in a human body and the motor is adapted to be controlled by a remote control outside the human body.

109. A pump according to claim 107, wherein the pump is adapted for implantation in a human body and the motor is designed to be powered by wireless energy emitted outside the human body.

110. A pump according to claim 106, wherein the pump is adapted for implantation in a human body and further comprising a control device for controlling the operation device.

111. A pump according to claim 110, wherein the control device comprises a remote control for controlling the operation device from outside the human body.

112. A pump according to claim 106, further comprising a magnet for driving the operation device.

113. A pump according to claim 112, wherein the pump is adapted for implantation in a human or animal and the magnet is adapted to control the pump from outside the human body.